SOUTHERN UTILIZATION RESEARCH BRANCH

Agricultural Research Service
United States Department of Agriculture

SOUTHERN REGIONAL RESEARCH LABORATORY
METAIRIE
SHREWSBURY
WESTWEGO
MISSISSIPPI RIVER
HARVEY
GRETNA
MARRERO
ALGIERS
ARABI
NewOrleans

VISITORS WELCOME

Visitors are always welcome at laboratories of the Branch, which comprises the Southern Regional Research Laboratory in New Orleans and six associated field laboratories located in Florida, Texas, Louisiana, and North Carolina. Groups will be given conducted tours of the laboratories. Arrangements can be made in advance to assure coverage of those phases of the program of greatest interest.

VISITING HOURS: Visitors are welcomed to the laboratory during working hours--8:30 a.m. to 5:00 p. m.--Monday through Friday.

TELEPHONE: Fairview 1441.

DIRECTIONS FOR REACHING THE SOUTHERN REGIONAL RESEARCH LABORATORY

The Southern Laboratory is located near Lake Pontchartrain, about 7 miles from downtown New Orleans.

By Taxi. From the business section, the fare is about $1.10 for individuals or groups of 4 or 5 persons.

By Automobile. Drive toward the lake on Canal Street to the Cemetary intersection, turn right, then left onto Canal Boulevard. Follow this road to Robert E. Lee Boulevard; then turn right, and drive about one mile to the Laboratory entrance.

By Streetcar and Bus. Board a Canal Street streetcar anywhere along the east side of Canal Street. Ask for a transfer. This streetcar goes northwest to the Cemetary intersection. Walk about half a block east; board a West End-Lake Vista bus. This will circle through the Lakeview and Lake Vista sections, arriving at the Laboratory entrance from the east.

ORGANIZATION

United States Department of Agriculture
Secretary of Agriculture .... Ezra Taft Benson
Assistant Secretary of Agriculture,
Federal-States Relations .... Ervin L. Peterson
Administrator, Agricultural Research
Service .... B. T. Shaw
Deputy Administrator for Research ..... G. W. Irving, Jr.
Director, Utilization Research .... G. E. Hilbert
Assistant Director, Utilization
Research .... W. M. Scott
Assistant Director, Utilization
Research .... J. R. Matchett

SOUTHERN UTILIZATION RESEARCH BRANCH [1]

Chief of Branch .... C. H. Fisher
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Special Assistant to Chief............. Mason DuPre', Jr.
Assistant to Chief .... J. A. Kime
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Business Manager .... F. M. Smith
Mechanical Superintendent .... J. B. Davies
Research Section Heads:
Analytical, Physical-Chemical and
Physics .... T. H. Hopper
Cotton Chemical Processing .... C. F. Goldthwait
Cotton Fiber .... C. M. Conrad
Cotton Mechanical Processing .... R. J. Cheatham
Engineering and Development .... E. A. Gastrock
Fruit and Vegetable .... V. H. McFarlane
Naval Stores Research (Olustee,
Florida) .... E. L. Patton
Oilseed .... A. M. Altschul
Sugarcane Products .... L. F. Martin
Field Laboratories: In Charge

Fruit and Vegetable Section

U. S. Citrus Products Station
Winter Haven, Fla .... M. K. Veldhuis
U. S. Fruit and Vegetable Products Laboratory
Weslaco, Texas .... F. P. Griffiths
U. S. Food Fermentation Laboratory
Raleigh, N. C .... J. L. Etchells

Oilseed Section

U. S. Tung Oil Laboratory
Bogalusa, La. .... R. S. McKinney

[1] SURB is one of the four Utilization Research Branches of the Agricultural Research Service. General information on the four Branches is given on the inside back cover.

Sugarcane Products Section

U. S. Sugarcane Products Laboratory
Houma, La. . . . . R. T. Balch

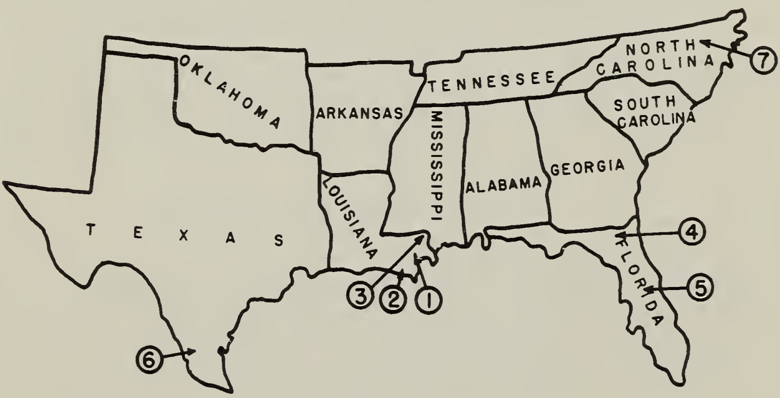
Naval Stores Research Section

Naval Stores Station
Olustee, Fla . . . . E. L. Patton

SOUTHERN UTILIZATION RESEARCH BRANCH

LOCATION OF SURB LABORATORIES

1. NEW ORLEANS, LOUISIANA
2. HOUMA, LOUISIANA
3. BOGALUSA, LOUISIANA
4. OLUSTEE, FLORIDA
5. WINTER HAVEN, FLORIDA
6. WESLACO, TEXAS
7. RALEIGH, NORTH CAROLINA



SOUTHERN UTILIZATION RESEARCH BRANCH

BACKGROUND

In 1938 Congress enacted legislation directing the Secretary of Agriculture to establish, equip, and maintain 4 regional research laboratories, one in each major farm-producing area, to conduct research to develop new and extended markets and outlets for farm commodities.

The Southern Utilization Research Branch, consisting of one of these regional laboratories and six smaller field stations, is seeking new and better utilization of Southern farm products. The research has these general objectives: To help farmers derive more income from their crops; to help industry convert agricultural raw materials into new and improved products; and to lower processing costs and improve quality of farm-derived products.

As a basis for determining the location of the regional laboratories and the commodities to be assigned initially to each, a survey was made to find out what research was underway throughout the country and what additional research was needed. Findings of the survey are reported in Senate Document No. 65, 76th Congress, entitled "Regional Research Laboratories, Department of Agriculture." Copies may be obtained from the Southern Utilization Research Branch.

In 1946 Congress enacted legislation called the "Research and Marketing Act," which authorized additional research on the utilization of agricultural commodities in the regional laboratories.

REGIONS AND COMMODITIES

The Southern Branch serves the Southern area, which comprises Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, and Texas. Commodities studied are cotton; cottonseed, peanuts, and other Southern-grown oil-bearing materials; rice; sugarcane; citrus fruits; sweetpotatoes, cucumbers, and other Southern-grown vegetables; pine gum; and the derived products and byproducts of all these crops.

BUILDINGS

The Southern Regional Research Laboratory is located near Lake Ponchartrain on a 40-acre tract of land. Construction of the main building began in June 1939. Its first unit was occupied in April 1941.

The building is U-shaped and has four floors. Floor area is about 4 acres; the "U" base is 211 by 63 feet; wings are 306 by 66 feet. Offices occupy the base of the "U" at three levels; one wing houses 72 chemical laboratories; the other, an experimental textile mill and pilot plants for chemical engineering

research. Nearly all areas of the building are air-conditioned. Other buildings include a power plant and storage facilities.

The Southern Branch also operates research laboratories at Olustee and Winter Haven, Florida, and at Weslaco, Texas.

The Department Library operates a branch in the Southern Regional Research Laboratory which provides technical library service.

RESEARCH PROGRAM

SURB research is organized into 9 sections. Fundamental, applied, and engineering and development researches are conducted within the Branch and in collaboration with other organizations which have similar interests or objectives. Some selected research is conducted by outside organizations under contract. Cooperative research is also conducted at the Southern Regional Research Laboratory under three industry fellowships, sponsored by the National Cottonseed Products Association, the National Confectioners' Association, and the National Canvas Goods Manufacturers' Association, and the National Tung Oil Marketing Cooperative, Inc.

Typical research activities of the 9 sections are:

COTTON FIBER. Conducts fundamental studies of chemical reactions involved in the conversion of cotton cellulose into useful products that retain the original fibrous form of cotton; conducts research on the fine structure of cotton and studies ways of chemically modifying the fine structure; investigates the morphology and composition of the cotton fiber; studies the interrelationships of fundamental physical properties of cotton fiber and their relationships to properties of cotton products.

COTTON MECHANICAL PROCESSING. Designs and develops mechanical processing equipment to improve the quality and lower the cost of cotton products; develops improved mechanical processing techniques for cotton; relates fiber properties to yarn and fabric properties; designs and develops cotton products for specific uses.

COTTON CHEMICAL PROCESSING. Develops chemical treatments and processes for enhancing the properties of cotton products for specific uses; investigates new methods of chemically finishing cotton textiles; conducts pilot-scale research on selected treatments and processes.

OILSEEDS. Investigates chemical and microbiological changes associated with handling of cottonseed and rice prior to processing; investigates meals and proteins of cottonseed, peanuts, and tung, in regard to properties affecting utilization; studies chemistry of fatty acids and develops new products from fatty acids of oils of cottonseed, peanuts, and tung; conducts research to improve existing methods of processing vegetable oils and to develop new oil and fat products; investigates chemical and physical properties of cottonseed and other oil-bearing materials, and the relation of processing conditions to utility of products; conducts research to improve food utilization of peanuts.

ANALYTICAL, PHYSICAL-CHEMICAL, AND PHYSICS. Applies, modifies, or develops analytical methods; investigates chemical composition, molecular structure, and chemical and physical properties of commodities; and their derived products; performs physical tests on cotton textiles.

ENGINEERING AND DEVELOPMENT. Conducts processing cost and technical evaluation studies in connection with process and product development research in the Branch; develops, by scaling up laboratory methods, useful products of higher quality and greater value from commodities under investigation in the Branch; scales up laboratory-developed processes to evaluate feasibility for large scale operation; consults and cooperates with other sections of the Branch on solution of chemical engineering problems involved in processing the commodities under investigation.

SUGARCANE PRODUCTS. Investigates the composition of sugarcane and sugarcane products, with special emphasis on the effect of different constituents on the yield and quality of final products; conducts chemical and chemical engineering research on the processing of sugarcane; conducts research to improve the use of agricultural commodities in confections; investigates recovery and utilization of by-products of sugarcane.

FRUIT AND VEGETABLE. Conducts chemical, biochemical, and processing research on fruits and vegetables of the South, including investigations of Florida and Texas citrus fruits, to improve quality and lower cost or processing; composition, canning, and processing of sweetpotatoes and other vegetables; brining of cucumbers, with special reference to factors contributing to softening and to the formation of bloaters.

NAVAL STORES RESEARCH. Develops methods and techniques which are used in determining chemical and physical properties and composition of pine gum, turpentine, and rosin; develops new or improved products directly from pine gum, or from derivatives of gum turpentine and gum rosin.

EXAMPLES OF PROGRESS

Typical research achievements of the Southern Branch are summarized here. Some are practical developments which either have been commercialized or are approaching commercialization. Perhaps an even greater contribution are others that illustrate the basic, pioneering type of research upon which practical investigations often are founded.

Members of this Branch have reported details of these and many other activities in more than 1,400 publications and public-service patents.

COTTON

Chemical treatments. Cotton, a versatile fiber, meets more different types of consumer needs than does any other fiber. But for all its usefulness, in some applications cotton

has lost ground to other fibers because it is inadequate or lacking in special properties. Natural cotton is not so rot-resistant as some of the synthetic fibers. It is less water-absorbent than flax. It is not so flame-resistant, soil-resistant, nor resilient as wool. It is weaker and less elastic than silk.

By chemical treatment, cotton can be transformed into new textile materials that retain the fibrous character of the original cotton but acquire new or improved properties.

A number of new, chemically modified cotton products have been developed. One which has been commercialized is partially acetylated cotton, produced by a process developed at this Laboratory. It is being used in covers for home ironing boards because of its superior heat resistance. "PA cotton" is also superior to plain cotton in rot resistance, electrical properties, and in resistance to some acids and chemicals.

Flame-resistant treatments for cotton textiles have been developed in cooperation with the Army Quartermaster Corps. An example is a durable flame-resistant and glowproof treatment, based on the use of tetrakis (Hydroxymethyl) phosphonium chloride, called THPC. Treatment with an aqueous solution containing THPC with methylol-malamine and urea forms an insoluble resin inside the fibers. This treatment also improves wrinkle and rot resistance. It can be applied on conventional processing equipment and by conventional finishing methods.

A treatment to make cotton tobacco shade cloth more durable in exposure to solar radiation has been developed. The inexpensive mineral pigment, lead chromate, applied to the cloth, causes the damaging ultraviolet rays to become ineffective. The commercial application of lead chromate is economical, considering the savings on replacement costs of untreated fabric. Two cotton manufactureres have produced treated cloth and have sold more than a million yards to shade tobacco growers in North Florida for trials. The treated cloth has proved usuable three seasons as top cover, in contrast to one season for untreated fabric.

Estimated savings to growers are $200 per acre each season; and this development has greatly lessened the danger of synthetic fiber fabrics displacing cotton from this market.

A special manner of shrinking by mercerizing ordinary cotton gauze gives a new surgical bandage of superior elasticity and clinging power. The all-cotton bandage fits snugly, allows more freedom of elbow, knee, wrist, or ankle than an ordinary bandage. The bandage is now being made commercially, and the Armed Services Medical Procurement Agency has ordered millions of the bandages. The new product costs less than half asmuch as other suitable bandages, and savings on the original purchases amounted to millions of dollars. Two companies are known to be manufacturing this elastic bandage commercially for civilian use.

Depending on the degree of modification, different cotton products can be made by carboxymethylation. Highly carboxymethylated cotton is water- and alkali-soluble; the mildly treated product is insoluble.

Aminization is another process of chemical modification of cotton. Aminized cotton has ion-exchange capacity, an entirely new property for cotton.

Fundamental Fiber Properties. A unique use has been made of dyes--to detect the stage of development in the cell walls of cotton fiber. Cotton mills are using this test to classify cottons for mechanical processing and for response to dyeing.

Cellulose consists of long, unbranched chains, made up of cellobiose units, each of which contains two disclike anhydroglucose members. New, fundamental research indicated that the cellulose molecule may be even much longer than previously reported. To aid in studying this subject further, two improved viscosity techniques for determining molecular weight were developed. They have been adopted by the American Society for Testing Materials.

A technique developed for loosening and stripping cotton's outer wall from the rest of the fiber has supplied sufficient quantities of the wall for observations of structure under the electron microscope and for chemical analyses. The information acquired is being applied to investigate the role of the primary wall in conventional chemical finishing treatments, such as kiering, bleaching, and mercerization.

Cotton's naturally high crystalline content, while considered an advantage for high strength, resistance to heat and moisture, and high modulus of elasticity, is not so advantageous for impact strength, toughness, and large extensibility before break. In research to improve the elastic properties of cotton, a treatment was developed which produces a more extensible, and more absorbent cotton fiber, which has also greater dyeing capacity and greater chemical reactivity than ordinary cotton. The treatment reduces the amount of crystalline cellulose, without causing loss of the fibrous structure nor of desirable physical properties.

Cotton Processing Machinery and Techniques. A new cotton-opener has been developed which gives the best means yet devised for fluffing tightly baled cotton at textile mills. Cotton so fluffed can be better cleaned by standard cleaning equipment, and less spinnable fiber is wasted. Yet the unique fluffing action causes no damage to the fibers. In about 3 years enough openers have been installed in textile mills to process about two million bales of cotton annually, and new installations are being made to handle an additional three-fourths million bales. One mill processing about 40,000 bales a year has saved up to a dollar a bale through less waste; and has achieved cleaner picker laps, better blending, no increase in neps, an increase in yarn strength, and improved appearance of yarn. On a 15-million bale crop, the potential savings to the textile industry range from 7-1/2 to 15 million dollars.

An attachment has been devised for use on looms to permit insertion of more filling threads to the inch than permitted on standard looms. Extra-tight fabrics woven in this way are more water- and wind-resistant than conventional fabrics. And ordinary materials woven with the aid of the device look

better, are more uniform, and are somewhat stronger than those woven without it. The loom attachment has been constructed by about 30 mills for experimental use. It is commercially available from two textile machinery manufacturers.

OIL-BEARING MATERIALS

Solvent-extraction and Filtration-extraction of Oilseeds. Technical data concerning the solvent removal operation and temperature control (to combat color fixation of cottonseed oil) contributed towards the first practice of commercial solvent extraction of cottonseed in this country. And commercialization of a new solvent process offers attractive possibilities for extending the solvent process to smaller mills.

Known as filtration extraction because of the principles employed, installations appear feasible with daily capacities as low as 75 tons of cottonseed--in contrast to 150 to 400 tons and more usually required. No prepressing is necessary.

The process is successful with cottonseed, rice bran, and soybeans, and may prove so with other oil-bearing materials. Equipment manufacturers are selling "packaged" plants. A mill in Mississippi applied the process successfully with cottonseed and soybeans in 1954-55. Potentially, the value of this new process may reach millions of dollars annually.

Cottonseed Pigments. Cottonseed pigments, if not removed or inactivated, detract from the nutritional value of meal and discolor the oil. In fundamental research here it was discovered that the pigments occur in glands in the seed. Additional related pigments besides the long-known, light-yellow pigment gossypol were discovered. A wealth of information on the structure of gossypol and the related pigments and their effects on oil color and meal quality has been accumulated.

Tailor-made fats and oils. By substituting acetic acid groups in glycerides of cottonseed or peanut oil, two kinds of new fats have been developed: Aceto-stearins and aceto-oleins, each tailored for different specific uses. Both types have potentialities for non-food uses, such as components of plastics. They seem to have potentialities for use as coatings for meat products, cheeses, fruits, and nuts. Tests made thus far to demonstrate their edibility have indicated that they will probably be satisfactory. The products can be prepared to have sharp melting points, within the range of 80° to 140°F. Below their melting points down to 20°F., aceto-stearins are nongreasy and flexible, which are unusual properties for fats. At freezing temperatures they are still flexible. They are practically odorless, colorless, and tasteless, resist rancidity and other forms of deterioration. Aceto-oleins can be incorporated in a formula as the liquid phase--with completely hydrogenated cottonseed or peanut oil as the solid phase--to obtain a margarine-like spread of good keeping quality--with an unusual plastic range (-10° to 120°F.).

New Antioxidants. Basic research on the causes and prevention of rancidity in cottonseed and peanut oils has led to the discovery and evaluation of effective new antioxidants to stabilize cottonseed and peanut oils. They are derived from conidendrin, a waste product of the pulping of western hemlock. About 10 to 15 pounds can be recovered from the pulping of 1 ton. A laboratory method of producing norconidendrin from conidendrin became the basis for pilot-plant production by a commercial company of two other derivatives, alpha- and beta-conidendrols. In tests these conidendrols inhibited oxidative rancidity in cottonseed and peanut oils, in lard, and in fat-containing candies; retarded aging and hardening of synthetic rubber; and stopped polymerization of certain vinyl-type monomers. The nontoxicity of the conidendrols is indicated in tests conducted at the Western Regional Research Laboratory.

Stabilities of Peanut Oils. The relation of composition to the stability of peanut oils from different varieties of peanuts was established. The stability is greatest in oils containing the smallest amounts of linolein. Oils from the "Spanish" varieties, containing the greatest amounts of linolein, are the least stable. Oils from the "Runner" varieties, containing the smallest amounts of linolein, are the most stable. Oils from the "Virginia" varieties, generally intermediate in linolein content, are intermediate in stability.

Improved Nutritive Value of Cottonseed Meal. Cottonseed meal has gained a new status as a feed for nonruminant animals as a result of research on improving nutritive value by changes in processing conditions. Cottonseed meals meeting certain specifications have been fed in unrestricted amounts to growing poultry and swine without any harmful effects. Preliminary experiments indicated that chicks and broilers thrive on feeds incorporating the suitable cottonseed meals in equal blend with soybean meal. Some cottonseed oil mills are producing the suitable meals and selling them for use in mixed feeds. These advances were achieved by cooperative research on a broad scale, with participation by members of the National Cottonseed Products Association, State Agricultural Stations, nutritionists and chemists of other agencies of the Department of Agriculture and of university laboratories, and numerous oil-mill operators. The program now comprises laboratory research on the chemistry of cottonseed processing; the development of improved chemical measures of nutritive value; practical experiments in mills; and containing feeding experiments with all classes of poultry and with swine.

Annual gains to the industry through the availability of cottonseed meal of improved nutritional values could amount to about $35 million.

Industrial Products From Peanut Meal and Protein. Light-colored and practically oil-free peanut meal, containing unaltered protein, has been produced by a process for removing 99 percent of the red skins of peanut kernels in conjunction with a special method of solvent extraction. This high-quality peanut meal and its component protein is suitable for

use in a number of new industrial products: A wool-like fiber; adhesives for use in papercoating mixtures, gummed tape, and similar products; a good plywood glue.

Rice Investigations. Improved procedures for milling rice, developed at the pilot-plant rice mill of the University of Arkansas' Institute of Science and Technology, Stuttgart, Arkansas, in contract research, are ready for commercial evaluation. It is believed that their use by mills should result in less breakage of rice grains and a higher yield of whole grain (head rice).

Information on the amount of oil potentially recoverable from different lots of bran was obtained through determinations of the fat content of rice bran for 8 of the varieties of rice grown in the South. Information has been obtained also on the influence of variety and of environment of growth on the composition of the products.

A study of the effect of heat on the viability of rice, based on data accumulated during three rice-harvesting seasons, showed that the resistance of rough rice to the destruction of viability through heat varies inversely with the moisture content.

Basic and technological information reported from this Laboratory has helped in making rice bran the source of a high-grade salad or cooking oil. Production of rice oil only 4 million pounds in 1949 is estimated to be more than three times that much at present. About 70 million pounds of rice oil a year, worth possibly 7 million dollars, is potentially recoverable from the domestic crop.

To help further in solving some of the problems of processing rice bran, refining and bleaching studies have been made. Rice oil low in free fatty acids was extracted from fresh bran with petroleum solvent; was refined and bleached by standard methods; and a high-quality, stable salad oil was produced by winterizing.

A process was developed for separating the wax from the other materials removed during refining--a byproduct which has potentialities for specific uses. A method was developed which leads to reduction in the amount of "fines", in the miscella (oil-solvent mixture) produced during extraction of rice bran.

Peanut Investigations. Through pilot-plant investigations, a basis for determining the conditions for roasting and other processing operations that will enable the manufacturer to produce peanut butter of the best possible flavor and keeping quality has been obtained. Findings in another study have made it possible to select--on the basis of its physical properties--hydrogenated peanut oil for commercially stabilizing peanut butter; and to incorporate adequate amounts under proper conditions which will provide a peanut butter free of oil separation. Improved continuous processes for the incorporation of Vitamin A in peanut butter have been developed for the Armed Forces.

The manufacture of peanut butter consumes as large a quantity of peanuts as all other peanut food products combined--about 287 million pounds of peanuts were used in 1952-53 to produce peanut butters. Procedures for the analysis and evaluation of peanut butter and peanut skins and other byproducts of manufacture, although in general use, had not been reported in the literature. SURB researchers have now described some of these procedures. A modified technique was reported for determining the stability of vegetable oils which reduces by 60% the time usually required to make this determination. Another modified method was outlined which gives consistently reproducible values for the moisture content of peanut butter.

It was established that colors of variously roasted peanut butters can be measured by a spectral reflectance method. This information may lead to the development of less complicated and less expensive means of making objective measurements.

Tung and Tung Products. Information has been obtained on ways to improve practices of handling and processing tung fruit and tung oil. It was found that removal of hulls before drying decreased appreciably the amount of heat required for drying; that prompt drying of hulled fruit reduces formation of undesirable free fatty acids; that it is not advisable to store moist material hulled from wet tung fruit, and that hulling should be correlated with mill operations, so that moist hulled fruit will be transported promptly to mills for drying to safe moisture contents; loss of kernels and kernel particles containing the oil can be minimized by hulling tung fruit containing from 15-20% moisture. It was found that tung fruit stored for long periods could not be pressed efficiently for oil, since the meal would not form a cake in the press; that solvent extraction of tung oil can result in superior yields and a good quality of oil; that oils extracted with petroleum naphthas, remain liquid, whereas with cyclohexane oil solidifies at room temperature; that solidified tung oil can be rendered permanently liquid by heat treatment.

Accurate methods of sampling and analysis for evaluation of tung fruit and its byproducts, have been developed; for example, for determinations of moisture and oil content and of the physical and chemical characteristics of tung oil.

Attention is being given to the development of entirely new uses for tung oil. As a part of this effort the molecular structure of alpha-eleostearic acid--the major constituent of tung oil--was established. This fatty acid is unusually adaptable to molecular alteration through the introduction of other chemical groups. The structure and properties of this component have been investigated by use of infra-red techniques and binary freezing-point procedures. Methods of converting alpha-eleostearic acid to its isomer, beta-eleostearic acid, have been devised, and the molecular structure of both acids has been established.

NEW RESEARCH METHODS AND DATA

Numerous evaluation methods and apparatuses have been developed to study the composition and the physical and chemical properties of the assigned agricultural commodities.

Determinations have been made of the content of organic acids in cotton; pigments in peanut skins; and trace metals in cotton and cottonseed. Analytical methods have been developed for the determination of copper in textiles; the pH in textiles and in cotton fiber; formaldehyde in cellulose formals; sulfate in nitrocellulose; starch in sweetpotatoes; gossypol in cottonseed and cottonseed products; inorganic phosphorus in plant materials; carotene; glycosidic methoxyl; and pectic substances. Spectrochemical methods have been developed for the analysis of vegetable oils. Investigations have been made of viscosities and densities of vegetable oils and their solutions in organic solvents; phase relations of vegetable oil- and-solvent mixtures at low temperatures; infra-red spectra; the porosity of fabrics; and the heat resistance of partially acetylated fabrics. New or improved apparatuses include an automatic recording balance and a device for measuring the thermal transmission properties of fabrics.

These and similar research methods and data are as useful to research in speeding conclusions as they are to industries concerned with the utilization of agricultural commodities.

FRUITS AND VEGETABLES

Citrus Investigations. The first concentrated frozen orange juice to be put on the market, so like the fresh juice in flavor, tests, and vitamin content, was largely the result of research at the Winter Haven Laboratory in cooperation with the Florida Citrus Commission. Manufacture of this improved frozen citrus product has brought many millions of dollars to citrus growers each year since the 1945-46 season when it first went into production. The annual value of frozen orange concentrate is approximately $200 million. In 1953-54 more than 65 million gallons were produced in Florida, using about 48 million boxes of oranges, or about half the crop of the State.

The process developed for producing this frozen product involves the evaporation of the juice to a concentration of approximately 65 percent solids, followed by the addition of fresh juice to restore flavor and to reduce ("cut back") the solids to about 42 percent, and then freezing. By essentially the same method, 4-fold frozen concentrates from grapefruit, tangerines, and blended oranges and grapefruit can be prepared.

Research established that citrus molasses may be added to citrus pulp to enrich its feed value without appreciably increasing its tendency to absorb moisture, and hence without introducing storage problems different from those for the

dried pulp alone. A simple, rapid procedure has been developed for estimating the soluble-solids in dried citrus pulp, as an index to the amount of molasses present or to the effectiveness of the addition of molasses in raising the content of soluble-solids in the feed.

Cucumber Investigations. Research is carried out jointly by the Food Fermentation Laboratory with the North Carolina Agricultural Experiment Station. Studies of cucumber brines established that the gaseous fermentation activity of yeasts below the surface of the brines is one of the main causes of bloaters. These hollow cucumbers, which must be diverted to low-cost products, cause serious financial losses to the industry. Species occurring during the gaseous fermentation of the cucumbers have been identified through studies of cultures from vats undergoing fermentations under conditions typical of the industry. Almost all the several hundred isolates belonged to the following six genera: Terulopsis, Brattanomyces, Eygosaccharomyces, Hansenula, Torulaspora, and Kleeckara. An investigation of another class of yeasts, responsible for formation of films on the surfaces of cucumber brines, showed species belonging to the genera Debaryomyces, Zygosaocharomyces, Endomycopsis, and Gandida.

Economic losses are suffered in the pickle industry due to "softening" of stored salt-stock during the brining of cucumbers. North Carolina Agricultural Experiment Station and Raleigh Laboratory learned that pectin-splitting ensymes are the cause of this softening, and that the cucumber plant itself is the chief source of the enzyme. The researchers developed a sensitive laboratory test whose use allows operators to detect immediately the first signs of the softening enzymes in their brines, so that the stock can be processed promptly, before deterioration gets really started. One plant manager reported that he saved 15,000 bushels of salt-stock by prompt use of this control treatment. Numerous varieties of cucumbers grown in different areas are being screened to give packers definite facts about the pickling qualities of the more desirable types of cucumbers.

What is believed to be the first preservation-prediction chart for yeast spoilage in sweet-cucumber pickles, showing the exact proportions of sugar and vinegar that need to be added during the manufacture of sweet-cucumber pickles so that they will keep safely, has been developed.

Process for Sweetpotato-starch Manufacture. A process for making white starch from sweetpotatoes, used for 10 years at Laurel, Mississippi, in a factory owned by a farm cooperative, was improved in research at the Southern Laboratory. Its application in a starch-manufacturing plant in Florida in 1945 demonstrated that the plant design, equipment, and process were satisfactory. The plant stopped manufacture in 1947, because acreage yields of starch were much lower than had been estimated and costs of growing the crop were high. Industrial use of the starch-manufacturing process depends on improvement of cultivation practices and farm equipment.

Recovery of Aconitic Acid. Half a million pounds of aconitic acid is recovered annually by the largest sugar mill in Louisiana from sugarcane molasses by a process developed at this Laboratory in cooperation with the manufacturer. Esters of aconitic acid are being used as plasticizers and in synthetic detergents. More complex derivatives than the esters are of interest as plant growth regulators and possibly in pharmaceutical or medical applications. Aconitic acid has been known for more than 75 years as the principal organic acid in sugarcane and derived products, but previously no practical method had been devised for separating it from the sirups or molasses, although its accidental separation as scale had long been a nuisance during sugar manufacture.

Advance Knowledge of New Varieties. Advance information is being obtained on the processing behavior to be expected of newly developed varieties of sugarcane that will enable processors to adapt machinery and operations to meet difficulties that may arise when these canes are in commercial production. Canes are milled by Louisiana State University in the Audubon Sugar Factory on the campus, under a contract with USDA, and the juices are processed by SURB. Composition of juices is analyzed--to correlate chemical composition with processing behavior. Information obtained in this work may mean thousands of dollars saved, through averting losses of sugar and by assuring continuous grinding throughout the season. It can also mean savings of millions of dollars a year in plant-breeding programs, by enabling the early withdrawal from planting tests of varieties proved unsuitable for processing.

Candy Investigations. In a small but completely equipped candy laboratory maintained at the Southern Laboratory in cooperation with the National Confectioners' Association, new ingredients or modifiers for candies produced from agricultural commodities, as well as altered formulas and candy-making procedures, are tried out. Many variations can be tried in a short time and the 5- to 10-pound batches can be remade at low cost until results warrant commercial-scale experiments.

In an investigation of the possible value and the proper application of antioxidants in stabilizing candies incorporating various fats, high-grade vegetable fats incorporated in candies did not require stabilizing against oxidation; but animal fats did. This protection is provided by incorporating into the fats Brewers' yeast and specially prepared oat flour, which are nutritive ingredients containing effective antioxidants. Butter mints incorporating yeast are now marketed by several firms.

NAVAL STORES: PINE GUM, TURPENTINE, ROSIN

Largely as a result of research conducted by the Department of Agriculture at the Naval Stores Station in Olustee, Florida, at least 25 centrally located modern plants today process about 90 percent of the United States pine gum crop by modern, efficient methods. Three research developments in particular have led to this modernization: Standardized methods of marketing the crude gum; steam-distillation; and the Olustee gum-cleaning process.

New and Improved Procedures and Products. Distillation procedures have been developed which make it possible to reduce the acidity of turpentine to an acid number below 0.5.

Rosin has been improved for use in metal resinates for coating materials by first treating with an aldehyde and then fusing with the metal. The new products, which contain a higher proportion of combined metal than other fused resinates and are more soluble, and have greater resistance to damage by oxidation, are being evaluated as paint driers, wood preservatives, special soaps, and corrosion inhibitors in greases. Licenses to operate under the two patents obtained on this process have been granted to manufacturers.

Pine gum is a complex of organic substances which offer almost limitless potentialities for the development of entirely new products. One new product, made directly from pine gum, is maleo-pimaric acid. One company is making this product commercially. It is of interest for use in plasticizers, resins, emulsifying agents, paper coatings, varnishes, printing inks, and similar products.

Pinane hydroperoxide, produced from a component of turpentine, has proved a superior catalyst in the manufacture of synthetic rubber. Unsaturated pinenes are converted to pinane through catalytic hydrogenation, and the pinane is converted to the hydroperoxide with air or oxygen.

Pinic acid is a product obtained through oxidation of alpha-pinene. Esterification of pinic acid gives products as satisfactory as esters of sebacic acid (from castor oil) as lubricants for the turbojet engines used in modern aircraft. Esters of pinic acid have possibilities also as plasticizers in making certain resin compositions that are flexible at low temperatures.

Other potentially valuable products, including polyester resins, polyamides, and urethane polymers, can be made from pinic acid.

GENERAL INFORMATION ABOUT THE FOUR UTILIZATION RESEARCH BRANCHES

Branch	Chief of Branch	Mailing Address	Area Primarily Served	Commodities Studied
Northern	W. D. Maclay	825 North University St. Peoria 5, Illinois	Ill., Ind., Iowa, Kans., Mich., Minn., Mo., Nebr., N. Dak., Ohio, S. Dak., Wis.	Agricultural residues; corn, wheat, and other cereal crops; soybeans and other oilseed crops.
Southern	C. H. Fisher	2100 Robert E. Lee Blvd. New Orleans 19, La.	Ala., Ark., Fla., Ga., La., Miss., N. C., Okla., S. C., Tenn., Tex.	Cotton, cottonseed, tung fruit, peanuts, rice, sugarcane, pine gum, citrus fruits, sweet-potatoes, cucumbers, and other vegetables.
Eastern	P. A. Wells	600 E. Mermaid Lane Philadelphia 18, Pa.	Conn., Del., Ky., Maine, Md., Mass., N. H., N. J., N. Y., Pa., R. I., Vt., Va., W. Va.	Eastern deciduous fruits; Eastern vege-tables; tobacco; milk products, animal fats; hides, tanning materials and leather; honey; maple products; wool by-products; plant Precur-sors of cortisone; and biologically active plant compounds.
Western	M. J. Copley	800 Buchanan Street Albany 6, Calif.	Ariz., Calif., Colo., Idaho, Mont., Nev., N. Mex., Oreg., Utah, Wash., Wyo.	Primarily Western fruits and tree nuts, Western vegetables. Poultry products, alfalfa and other forage legumes, wheat, rice, wool, sugar beets, and dry beans and peas.

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